of a γ-Mn-based, Mn-rich alloy of IrMn, RhMn, RhRuMn or the like, and, in addition, the mutual diffusion between Ru and the ferromagnetic layers B and A could be prevented. Therefore, the alloy is favorable to the layers B and A. If Co is used for the layers B and A in place of the CoFe alloy, J will be around 2/3. In addition, as in Fig. 21, the thickness range of the antiferromagnetically coupling layer capable of still maintaining the stable antiferromagnetically-coupling function even after thermal treatment at 270°C for 1 hour or so is narrowed for the Co layers, as compared with that for the CoFe layers.

The surface smoothness of the antiferromagnetically coupling layer is also important for the purpose of maintaining the thermal stability for the antiferromagnetically-coupling function of the layer. If the level of the surface roughness of the layer is larger than the thickness of the layer itself even in a minor region of 10 nm^2 or so, the thermal stability for the antiferromagnetically-coupling function of the layer will be lowered. Therefore, it is desirable that the level of the surface roughness of the antiferromagnetically coupling layer is not larger than the thickness of the layer itself.

Table 9 shows the variation in the sheet resistance Rs of spin valve films, the sheet resistance change ΔR and the resistance change rate ΔR/R, relative to the varying thicknesses of the ferromagnetic layers A and B. Fig. 22A,

Fig. 22B and Fig. 22C are graphs of resistance change in spin valve films versus the applied magnetic field.

Table 9

Spin Valve Film Constitution:

Ta/Au/CuMn/ferromagnetic layer A (CoFe)/0.9 nm Ru/ferromagnetic layer B (CoFe)/2.5 nm Cu/free layer (4 nm CoFe)/Ta

Thermal treatment: at 270°C for 1 hour

Thickness of Ferromagnetic Layer A (nm)	Thickness of Ferromagnetic Layer B (nm)	Resistance Change Rate ΔR/R (%)	Sheet resistance Rs (Ω)	Sheet resistance Change ΔRs (Ω)
7	7	7.2	7.5	0.54
5	5	8.0	9.8	0.78
3	3	8.6	12	1.03
2	2	8.4	14.1	1.18
1	1	8.0	15.3	1.22
0.5	0.5	5.9	15.6	0.92

As in Table 9, the thicknesses of the ferromagnetic layers B and A are preferably from 1 to 5 nanometers for obtaining a high resistance change rate, but more preferably from 1 to 3 nanometers. With the layers B and A each having a thickness to fall within the preferred range, the pinned magnetic layer is stable to the applied magnetic field (that is, the resistance decreases only a little even in the applied magnetic field of +600 Oe), as in Figs. 22A to 22C, and, in addition, the sheet resistance Rs of the spin valve films is high and the sheet resistance change ΔRs is on a satisfactory level. The reproduction output is proportional to the product